

ASPHALT INSTITUTE

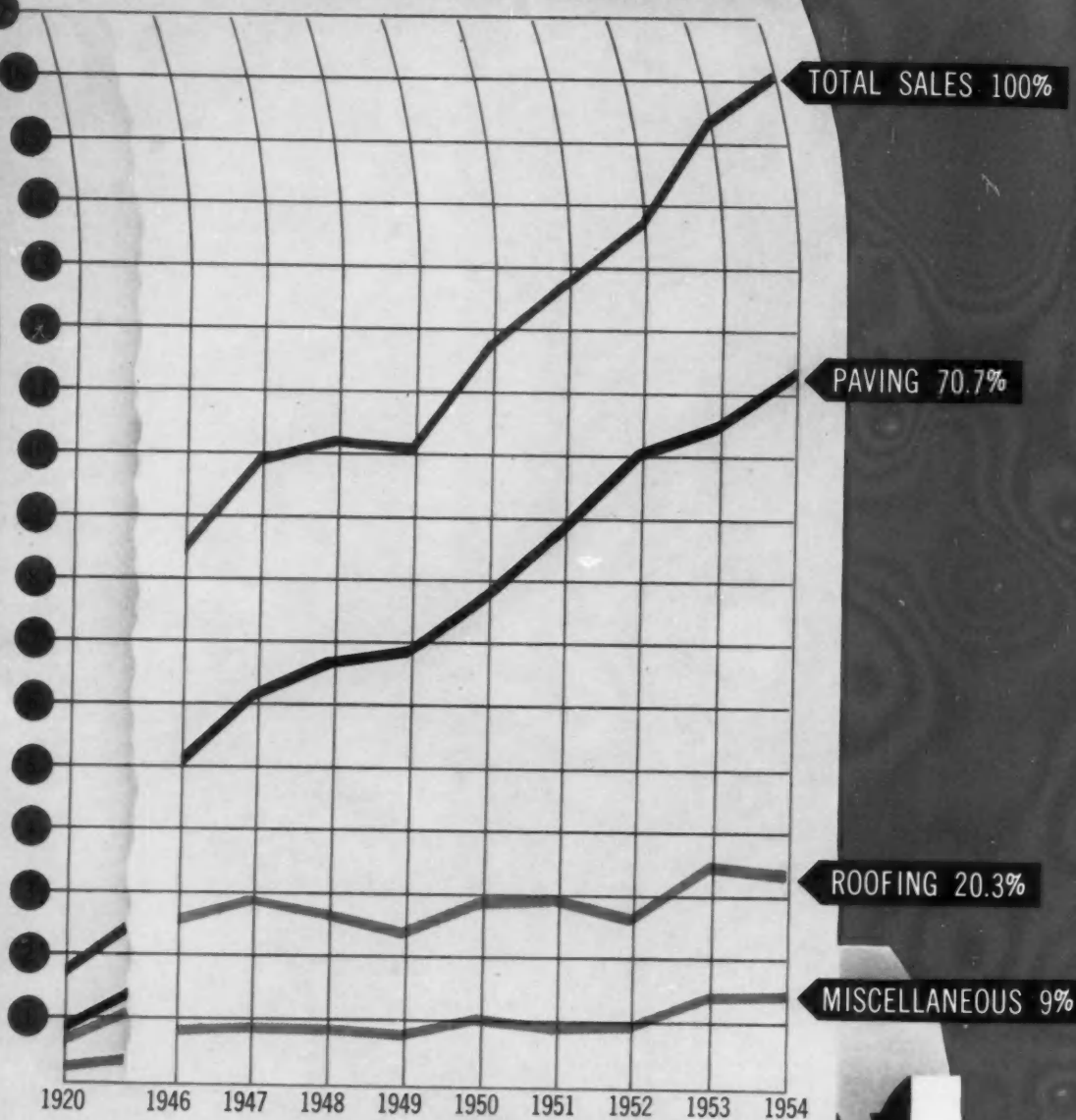
Quarterly

APRIL, 1956



MILLIONS
OF TONS

SOURCE: U.S. BUREAU OF MINES ANNUAL FIGURES
CHARTED BY THE ASPHALT INSTITUTE APRIL 1956



Annual Sales of
PETROLEUM ASPHALT and ROAD OIL
to Domestic Consumers in U.S.A.
1920 and POST-WORLD WAR II

Wider Highways—Greater Safety— Less Cost

IN view of the current discussion concerning a proposed increase in Federal Aid to highways and the need for early construction and improvement of the 40,000-mile Interstate System, it is indeed timely to review certain details relative to highway design and cost. While the motor vehicle has been engineered to obtain the last ounce of power from a gallon of gasoline, highways as yet have not been engineered to get full value from the gasoline tax. After forty-five years of designing and building roads and streets, this writer has no hesitancy in stating that pavements today often cost more than they should, and that research and experimental study have not been carried out to the maximum degree. This is no small matter, for potential savings on the Interstate System alone can amount to as much as three billion dollars. When to this figure is added the additional possible savings in constructing the remainder of the Primary System, it becomes apparent that future construction methods will have a marked bearing on the rates of taxation for those who must pay the highway bill.

One may ask why such savings have not been achieved previously on a wider scale. There are several reasons. One is the constant turnover in personnel in many State Highway Departments, due both to political change and to all-too-low salary scales. This produces a lag in development of trained assistants who can fully evaluate native resources and determine the most efficient use of soils and mineral aggregates for securing truly permanent foundations at reduced costs. Another reason has been fear of increasing weight of trucks and buses, and hence over-emphasis on the wearing course, or so-called pavement proper. At times this situation has been aggravated by making designs on the basis of approximately equal cost of the several pavement types rather than of equal strength, a practice which has tended to lessen competitive bidding rather than aid it.

The recent WASHO test road study, however, (see AIQ, Jan., 1956) indicates that fears with respect to heavier loads are quite unnecessary. On the Malad, Idaho, test loops, which underwent the constant pounding of the heaviest trucks, and at all seasons, it was demonstrated conclusively that a four-inch thickness of asphalt pavement, placed over a well consolidated granular foundation and adjacent to firm shoulders, could withstand the most severe traffic without difficulty. Inasmuch as there are but few areas, either in the United States or elsewhere, where permanent foundations may not be secured at low cost, it is at once apparent that future heavy-duty highways, whether dual or two-lane, can be paved for much less cost than previously believed possible. Moreover, by means of the savings resulting from this reduced pavement thickness the very improvements most needed to achieve greater highway safety—increased pavement width, and wide, strong shoulders—can be obtained for no more than previously paid for conventional narrow roadways.

The findings of the WASHO test are not entirely new. Many engineers have observed such pavement behavior on individual local projects, and several states have applied these principles on a wide scale. This extensive, controlled test, however, provides the needed final scientific appraisal, indicating clearly the dimensions that really apply for modern traffic: (a) more width rather than more thickness, (b) permanent foundations, and (c) solid shoulders. These all can be obtained at less cost if presently well understood procedures are but universally applied. The construction of costly, massive wearing courses has been proved quite unnecessary for modern highway traffic.

—BERNARD E. GRAY

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EDITOR

Richard C. Dresser

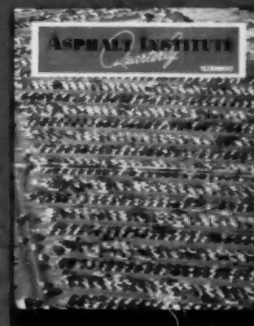
Contents

	PAGE
Asphalt Pavements—The Top Choice for Parking Areas	4
The Charm and Utility of Asphalt Driveways	7
Chances Are—An Asphalt Street Borders Your Home	8
Better Curbs With Hot-Mix	10
Thirty-seven More Miles of Asphalt Resurfacing On Pennsylvania Turnpike	12
A. W. Dow—Asphalt Pioneer	13
Asphalt Institute Engineers	14
Members of The Asphalt Institute	15

Cover

Acres of automobiles cover the mammoth parking space that serves the Crenshaw Shopping Area in Los Angeles' Crenshaw-Santa Barbara section. Constructed entirely of heavy-duty asphalt pavement in 1947, the huge lot is typical of hundreds of such asphalt-paved installations built since the end of World War II to accommodate shoppers in our expanding suburbs.

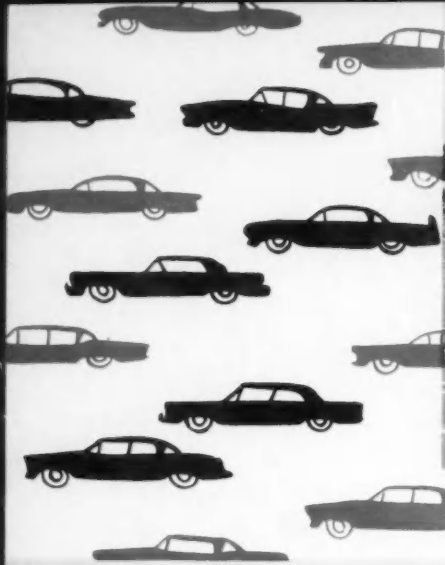
Photo: Spence Air Photos



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Asphalt parking lot adjacent to Woodward & Lothrop's suburban department store, Chevy Chase, Md., accommodates 719 cars. Space provision for 100 more is being planned.



The Pentagon's west parking lot has rugged asphalt surface.

Photo: U. S. Bureau of Public Roads



Jammed offstreet lot in midtown New York City.

Photo: Ewing Galloway



THE competition for space on our outmoded road network is a subject in which all motorists, from personal experience, are well versed. Every day millions of drivers fight the battle of the traffic jam, seeking room to maneuver their vehicles on narrow, winding, woefully inadequate streets and highways.

This portion of the motorist's dilemma has received top-level recognition. The need to modernize existing roads and to build new ones is a topic that commands nationwide attention every day. Most states are frantically enlarging and improving their highway networks as never before, and a federal bill should soon be enacted. An all-out effort is underway to establish a highway system that will not only unclog existing bottlenecks but will also absorb adequately and safely the millions of new vehicles pouring out of factories every year.

THE SEARCH FOR PARKING SPACE

Competition for space by the motorist, however, extends beyond the highway. Every driver must some time reach a terminal, the all-important place where he leaves his vehicle. To each member of the family—the husband who goes to business, the wife who does the shopping, the teen-ager who borrows the car for a Saturday night movie—the problem of parking is a vital one indeed. The effort to find parking space within reasonable distance from ultimate destinations

can often be far more exasperating and costly than bucking traffic enroute.

The need for increased parking facilities in most urban areas and in many suburban commercial centers grows with each increase in population, with the production of each new motor vehicle. In this day of automotive transportation (transit patronage has slumped sharply in recent years) the matter of providing adequate parking space has become one of the most vital factors in the economic life of the American urban and suburban community.

THE DOWNTOWN SITUATION

Although nearly all cities are making valiant efforts to cure their parking headaches, the remedies have been slow in taking hold. The Automotive Safety Foundation's excellent bulletin *What Parking Means To Business* puts it this way:

"One thing seems evident: The long-festering parking problem is not going to get itself conveniently lost in the process of community face-lifting and circulatory improvement. Without specific and positive action, it is bound to get worse.

"Most measures for expediting the traffic flow into and out of our cities, in fact, tend to aggravate the parking problem. Restricted zones and no-parking streets

ASPHALT PAVEMENTS

The Top Choice for Parking Areas

Large asphalt spreader lays heavy-duty asphalt surface for 3,000-car lot, Signal Hills Shopping Center, St. Paul, Minn.



have helped to relieve congestion on the existing street plant, but simultaneously much-needed parking space has diminished. Urban expressways, now being built in ever-increasing numbers, can efficiently handle far greater volumes of traffic than conventional arteries; but more motor vehicles pose a corresponding demand for more terminal facilities. Meanwhile, the postwar boom in building construction has taken thousands of vacant lots formerly used for parking. Development of new lots and garages has not kept pace with needs; and convenient parking space downtown is often at a premium, when available at all."

Although, as studies have shown, the advantages of the downtown area as the center of retail trade assure its prosperity, parking remains its chief disadvantage, a drawback which undoubtedly is affecting the growth of retail business in that section. Suburban retail centers, too, in many parts of the country, face serious problems imposed by lack of sufficient parking space. Merchants in numerous shopping areas geared to automotive transportation and constructed only seven or eight years ago now find their once adequate parking facilities hopelessly clogged with potential customers waiting for vacant space to pull into.

SUBURBAN PICTURE BRIGHTER

On the positive side of the ledger, far-sighted planners of suburban retail centers are building for the future as well as the present. In the phenomenally growing suburbs, where virtually all shopping is done by car, ample free parking space is absolutely essential to the success and growth of any retail business establishment, and no new suburban centers are now being constructed without such spacious accommodations for vehicles. In fact, the ratio of parking area to retail space in these centers is often as much as 4 to 1; and, in nearly every case, this new parking space is acquiring a dark, tough blanket of asphalt as modern as the handsome commercial facilities it serves.

ASPHALT'S POPULARITY

The popularity of asphalt pavements among private parking area owners and municipal operators is traditional. These officials long ago discovered that the many qualities which combine to make asphalt the ideal surfacing material for roads, streets and superhighways are similarly suited to the construction of open parking lots, which account for about two-thirds of all off-street parking. The result has been that

nearly all existing paved lots in the United States have an asphalt surface, and that all new construction, almost without exception, is asphalt. To see a surfaced parking lot today without an asphalt pavement is rare indeed.

The reasons for asphalt's predominant use in parking lot construction are numerous and well known. Asphalt pavements have demonstrated beyond question their great durability and low maintenance costs under a wide variety of conditions. Quickly and easily constructed, they have a most pleasing appearance. Their dark color not only affords excellent contrast for vehicle space markers but also offers freedom from the harsh glare of sunlight. They are completely unaffected by ice-removing salts, an important consideration in areas where such chemicals must often be applied in winter for ice control.

In rejuvenating and modernizing other kinds of pavements asphalt has no peer. Surfaces of any type—gravel; broken portland cement concrete slabs; brick or block; or asphalt pavements of long service requiring surface restoration—can easily be transformed into new, smooth and excellent pavements through asphalt resurfacing.

LESS COSTLY CONSTRUCTION

In the desperate quest to provide adequate parking space, the cost of paving is a primary consideration. Not the least of the many advantages of asphalt pavements is this highly important feature: *they cost far less to construct than any other pavement type.* Because the purchase or rental of property for parking facilities involves considerable expenditure, experienced parking lot operators and municipal officials alike have long insisted upon economical asphalt construction to the virtual exclusion of all other pavement types. Asphalt's outstanding performance record in the parking field affirms their selection. By following their lead, future builders of downtown car parks, of urban "fringe" lots and accommodations in suburban centers, can assure themselves of getting the best possible pavement at the least cost—in both initial construction and maintenance.

Asphalt pavements for parking areas can be constructed to meet any particular set of conditions, whether for the lightest passenger car or for the heaviest truck and trailer. Inquire at your nearest Asphalt Institute office about the illustrated publication, *Asphalt-Paved Parking Areas* (Information Series No. 90) which contains design and construction specifications.

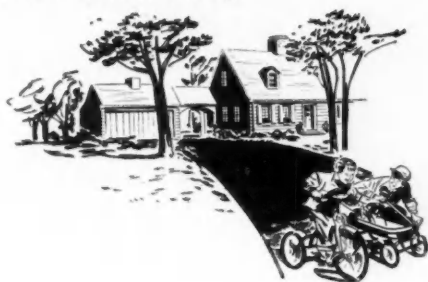
Green Hills Village Shopping Center, near Nashville, Tenn. Vehicle space markers are highly delineated against dark asphalt pavement.

Photo: Public Works Magazine



The Charm and Utility of

ASPHALT DRIVEWAYS



JUST as a thick green turf and well-stationed shrubs and trees endow homes and other buildings with a special beauty, so does a dark, rich carpet of asphalt on the driveway contribute to the harmony and charm achieved through good landscaping. For this reason and many others, landscape architects, engineers, building contractors and home owners have long utilized asphalt to meet their driveway paving requirements. Asphalt driveways for parks, cemeteries, private estates, institutional grounds, and for small homes in modern housing developments are usually specified not only because they are elegant and neat in appearance but also because they cost less than any other type to build and maintain. Moreover, contractors can usually pave the average home driveway with asphalt from start to finish in just a few hours with relative ease.

DRIVEWAYS HAVE MANY USES

As one of the home's most important outside utilities, the driveway must withstand a surprising amount of wear and abuse. Functioning primarily as a private way for vehicles to travel from house to street, it also serves as parking space



Asphalt, the modern driveway pavement, lends beauty and charm to the home's landscape.

For millions of small homes like this, less costly asphalt driveways are giving superior service.



Photo: Harold M. Lambert Studios

for the cars of the family and guests. Tradesmen utilize it to make deliveries, and it often must bear the weight of heavy trucks. In many homes the driveway doubles as a playground for children.

Consequently, it is essential that the driveway pavement be smooth, yet skid resistant and safe. It must be free from mud and dust, and it must be easily cleaned. Above all, it must have the ability to "take it," to resist the strains imposed upon it by alternate freezing and thawing in winter, and by the heat of summer. This means that the pavement must have flexibility and resiliency as well as toughness and durability.

Since asphalt pavement embraces all these features, it is far and away the leading choice for driveway surfacing. In countless installations throughout the land, it performs its duties efficiently and satisfactorily while lending beauty and charm to the landscape.

Asphalt-Paved Driveways (Information Series No. 91) contains much information about driveway construction and design useful to builders and contractors. Inquire about this Asphalt Institute publication at your nearest Institute office.



Residents of beautiful Chevy Chase, Maryland, take pride in their fine, durable asphalt streets.



Smooth, dark asphalt pavement blends into this tropical residential setting. Bal Harbor, Miami, Fla.

Chances are
an
ASPHALT
STREET
Borders
Your Home





Safe and comfortable driving—that's what asphalt streets provide for residents of University Park in Dallas.



On Drexel Drive, Highland Park, Texas, heavy-duty asphaltic hot-mix has resurfaced an old concrete pavement.

IN this postwar era, one of the wonders of our industrial and economic growth has been the development of Suburbia, U.S.A. Radiating steadily outward from our cities like signals from a radio transmitter, the American suburb covers a gigantic area—and it continues to expand. Neatly planned housing and apartment developments sprawl over a countryside where families once picnicked or went for a Sunday drive. Builders have transformed fields and pastures and woodlands into communities housing millions of people.

ASPHALT IS PART OF THE PICTURE

Prominent in this booming panorama of residential living is the asphalt road. Because, among other things, the value of a piece of property is usually enhanced by the existence of a bordering dustless, mudless, all-weather street, most subdivision builders automatically and without hesitation turn to the one pavement that will best do the job of conserving their investment. Fortunately, most housing developments and residential areas enjoy paved streets. Asphalt is the reason why they do.

Because asphalt has so long and so exclusively been a part of the residential scene, the average home owner usually takes for granted the various vital functions performed by the pavement in front of his house. It provides for him and his family safe and comfortable driving. That's its most important job. The suburban dweller today uses his car nearly every time he leaves the house, and asphalt pavement is giving him the smooth, efficient ride he has every reason to expect from it.

Asphalt pavement also enhances the appearance of his property and that of his neighbors. Its dark, low-glare surface provides a pleasing contrast to green lawns and other landscaping. Street noises, too, are reduced because of the pavement's velvety texture and smooth, seamless surface.

RAPID, LESS COSTLY PAVING

These features desirable to the home owner, but which he perhaps only passively considers, are things of which the builder is usually very much aware. Since he is the one responsible for putting the streets in, he looks to the many *other* advantages of asphalt pavements, too. They enable quick and easy surfacing, for one thing. A builder likes to get his roads paved rapidly

after his houses are up and the gas and water lines in. Asphalt pavement is the only type that accommodates him. An experienced contractor can lay several blocks of pavement a day, permitting traffic on it in a matter of hours.

The low cost of asphalt construction is another advantage that attracts builders to its use. Asphalt pavements always cost less than other types. Builders also know that little maintenance will be required for many years, and that here, too, costs will always be low. If, to repair utility ducts such as gas lines or water mains, it becomes necessary to tear up a section of the street, the work can be done at little cost, with little inconvenience to traffic, and the pavement restored in short order to perfect condition.

IN OLDER AREAS

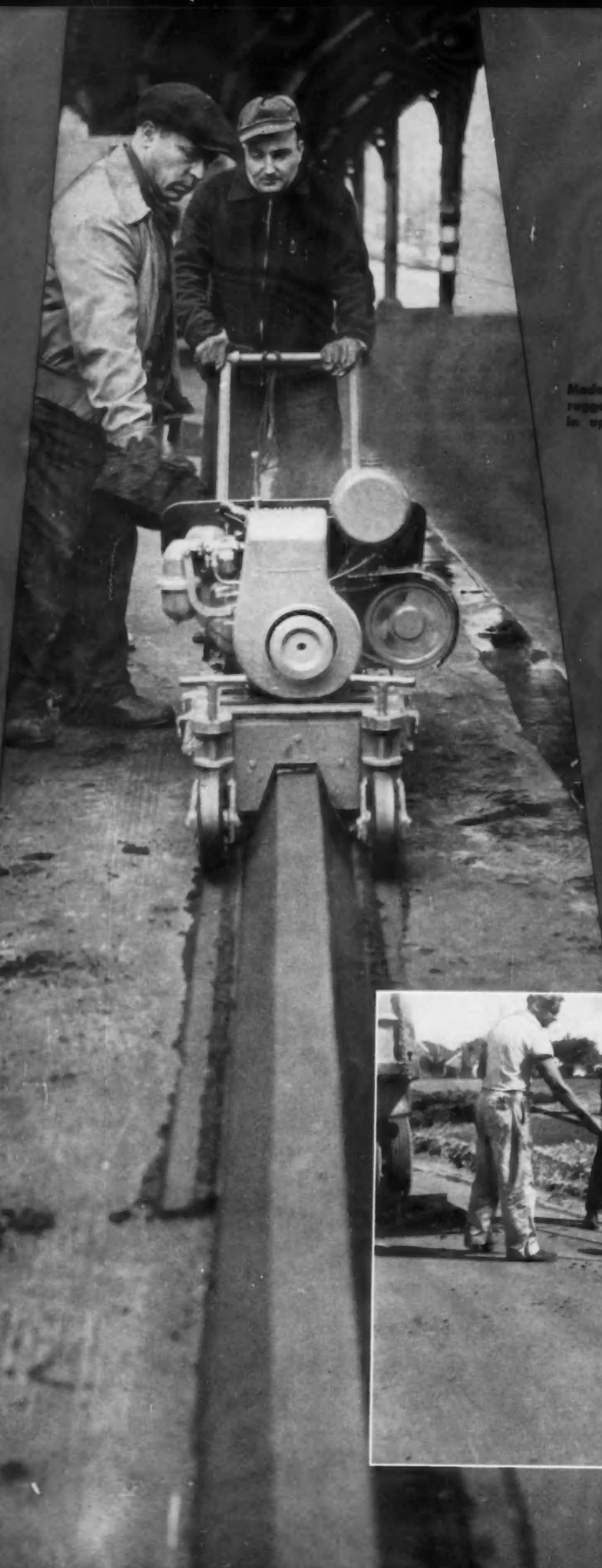
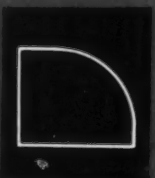
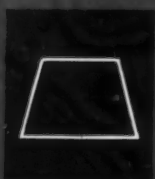
Residents of older suburban sections have first-hand knowledge of the facility with which asphalt streets can be maintained and improved. Many streets in these areas, once required to carry only fairly light traffic, have since become feeder arteries for vehicles traveling to newer outlying suburban developments, a circumstance necessitating their conversion into wider, heavier-duty thoroughfares. Contractors have easily been able to accomplish this transformation by asphalt widening and resurfacing, even in cases where the original construction was rigid slab pavement. In fact, when such old concrete roads need rehabilitation, asphalt resurfacing is the only satisfactory and economical method.

Side streets not requiring such improvement, however, have served well for many years with little or no maintenance, their asphalt surfaces contributing to and preserving the special charm of well-established neighborhoods.

A typical familiar American scene is the long old residential avenue, its borders lined with stately trees forming a majestic canopy over a dark, velvety carpet of asphalt—a fitting tribute to the pavement that ranks second to none the world over.

The Asphalt Institute illustrated bulletin *Asphalt-Paved Residential Streets*, soon to be available, contains valuable design and construction information. Inquire about it at your nearest Asphalt Institute office.

Curb can be molded in variety of shapes by new placing machines.



Modern curbing machine quickly places rugged asphalt curb for safety island in upper Manhattan, New York City.

Photo: World-Wide Photos

Placing hot-mix asphaltic curb for drive at Mt. Olivet Cemetery, Detroit.



THE inherent versatility of asphalt makes this extraordinary petroleum product adaptable to literally thousands of uses. Researchers constantly seeking to develop new uses never cease to marvel at its wide variety of present applications and its almost unlimited potential for use in still other untapped markets.

In the laboratory, factory and field, methods for improving existing types of asphaltic construction are also continually being sought and developed. Asphalt equipment manufacturers, for example, over the years have brought out new types of distributing and finishing machinery to facilitate road paving, to improve the quality of the work, and to cut labor costs. How much more efficient is the construction of an asphalt pavement today than it was twenty or even just ten years ago!

Builders and engineers today are exhibiting keen interest in a type of asphaltic structure that has been employed for some years but which recently has seen substantial improvement largely through the development of new and better construction machinery. The structure is the asphalt curb and gutter, and its use is steadily on the increase.

HOT-MIX CONSTRUCTION

Asphaltic curbs, with or without gutters, are constructed with a heavy-duty asphaltic hot-mix. They give excellent service wherever such structures are usually employed—such as at highway intersections, along median strips, as part of traffic safety “islands,” on city and residential streets, and in parking areas. New placing machines now on the market can be equipped with apparatus to mold the asphaltic mixture into

a variety of shapes and forms satisfying any requirement or taste.

Construction of asphaltic curbs is remarkably quick and much less expensive than concrete, an advantage which naturally appeals to economy-conscious builders. Costs range from about 50¢ to 70¢ per lineal foot. The new machines have precluded the forms formerly necessary in curb construction and can place more than 2,000 feet of curbing a day. (Readers are invited to inquire at any Asphalt Institute office about the publication *Asphalt Curbs and Gutters* [Information Series No. 92], containing useful additional construction information.)

HIGHLY DURABLE

This type of curb has proved extremely durable and has demonstrated beyond question its ability to withstand heavy abuse. When tires of cars or trucks bump against it they do no harm. Ice-melting chemicals which cause rigid curbs to scale and pit have no effect whatsoever on asphaltic curbs. They require little or no maintenance.

Asphalt's waterproof quality gives it a distinct advantage over any other pavement type in the construction of curbs and gutters. The turbulent flow of water from heavy rains is a force which can in time wreak considerable havoc with concrete drainage structures. Asphaltic materials have shown themselves to be far superior than rigid types in such hydraulic installations as canals, sea walls, groins and jetties, which are subject to fierce buffeting by water and wind. Combination curb and gutter installations have performed admirably under such conditions of high water velocity, a further reason why builders and engineers are perpetuating their use throughout the country.

Better CURBS with Hot-Mix

For parking areas, asphaltic curbing gives superior service under such conditions as shown here.



Curb-laying operation on a Kansas highway. Structures are not affected by ice-melting salts in winter.



37 More Miles of ASPHALT RESURFACING on the Pennsy

THE year 1954 saw twenty-two miles of worn and broken 14-year-old concrete pavement on the Pennsylvania Turnpike undergo a complete face-lifting through asphalt resurfacing (see AIQ Jan., 1955, pp. 8-9).

Last year the Turnpike Authority called for the resurfacing of 37½ more miles, bringing to nearly sixty the total mileage thus far improved and strengthened with asphalt pavement. The resurfacing of forty additional miles in 1956 is now being planned.

Prior to placement of the 3-inch asphaltic binder and wearing courses in the 1955 work, the contractors carried out extensive subsealing of the old concrete slabs. The accompanying pictures illustrate the procedures employed during construction operations.



Close-up of old, scaled concrete pavement.



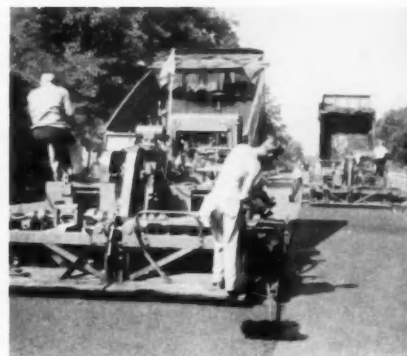
Plugging with asphaltic mix one of 210,251 holes drilled for undersealing operations.



To prepare old concrete surface, old filler material was removed from slab joints.



Refilling joints with cold asphaltic mixture. Pavement was then swept clean of debris.



The 2" binder course laid, finishers here apply 1" heavy-duty asphalt wearing surface.

Completed pavement on left lanes. Rollers finish compaction of binder course on right.



Four lanes of dark, low-glare, tough asphalt pavement give motorists safe, comfortable driving day and night.



nnsylvania Turnpike

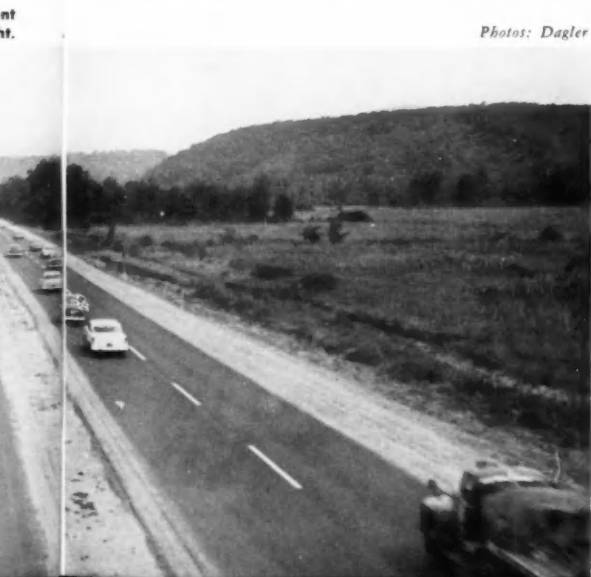


Forcing hot asphalt through holes in concrete to underseal and steady old slabs before resurfacing.



Just to make sure, wearing surface is checked for smoothness before final rolling.

Photos: Dagler



A. W. DOW
1866-1955

Asphalt Pioneer

Allan Wade Dow, one of the early pioneers in the field of asphalt paving and technology, died on December 8, 1955, at his home in New Milford, Connecticut, at the age of 89. At the time of his death, Mr. Dow headed the consulting engineering firm of A. W. Dow, Inc., New York City.

A member of the graduating class of 1888 from Columbia University's School of Mines, A. W. Dow, during his long career, devised and developed methods for testing asphaltic materials that are standard throughout the world. His contributions to asphalt technology, and to the industry he so devoutly served, have aided immeasurably in the establishment of asphalt as the world's foremost paving material.

It was during the period 1889 to 1894 while he was an assistant chemist of the Barber Asphalt Paving Company in Philadelphia that Mr. Dow devised a method for testing the consistency of asphalt cement by measuring the time and depth of penetration of a needle in a given sample. He also later invented a machine for measuring the ductility of asphalt. Refinements of the Dow Penetration and Ductility machines are standard equipment in most asphalt laboratories today.

In 1895, Dow succeeded Clifford Richardson as Inspector of Paving for the District of Columbia, serving in this post for twelve years. This period saw him gain considerable renown through his aid in establishing many city and state paving departments and laboratories for the testing of paving materials. He left this position in 1906 to go to New York and to found, with Francis P. Smith, the firm of Dow and Smith, consulting engineers and specialists in road paving and paving materials. The partnership endured until the death of Smith in 1932, when Dow reorganized and incorporated in his own name. He also served as Vice President and Chief Engineer for Colprovia Roads, Inc., from 1935 to 1939.

As one of the country's top paving experts and research chemists, Mr. Dow's services were in constant demand. His travels took him the length and breadth of the United States and into Canada to supervise innumerable paving projects of all types. Although, as a chemist, his early work was necessarily confined to experimentation with natural asphalts, he became a champion of asphalt refined from crude petroleum from the time it was first introduced in the United States in the early 1900's, and he battled to secure recognition for it. Of today's vast asphalt market in the U. S. natural asphalts constitute only a negligible proportion.

In devoting a lifetime to the betterment of pavement construction, both in the laboratory and in the field, A. W. Dow exerted profound influence upon those who have succeeded him. *The Asphalt Institute Quarterly* takes pride in recognizing some of the significant and noteworthy achievements of one of the great early builders of the asphalt industry.



MERRITT R. ROYER

District Engineer at Kansas City

MERRITT R. ROYER, District Engineer for The Asphalt Institute's Midwest Division, provides engineering service for a territory that covers Arkansas, Kansas, Missouri and Eastern Nebraska. His office is at 15 West Tenth Street, Kansas City, Missouri.

Mr. Royer joined the Institute in July, 1954, following twenty years with the Kansas State Highway Commission. After graduating from the Kansas State College School of Engineering in 1935, he served for six years in the Commission's design and construction departments. Transferred to the Materials Department, he assisted, as Stabilization Engineer, in mix design and field control of all types of stabilized base and bituminous surface construction. For two months each year he conducted an Engineering Training School on asphalt construction.

Mr. Royer is a licensed Professional Engineer and a member of the Kansas Engineering Society, of which he is a past president. He also holds membership in the Association of Asphalt Paving Technologists and the Highway Research Board.

ASPHALT INSTITUTE ENGINEERS



LOUIS R. HOVATER

Area Engineer at Los Angeles

AREA Engineer Louis R. Hovater, together with District Engineer Don G. Evans, covers Arizona and Southern California from offices in the Halliburton Building, Los Angeles. Both men serve the Pacific Coast Division of The Asphalt Institute.

Upon graduating from the University of Alabama in 1948, Lou Hovater became a junior civil engineer for the Commonwealth and Southern Corporation in Birmingham. He later served with the California Division of Highways working on design and construction of freeways and interchanges. In March, 1951, he joined the Donald R. Warren Company, architects and engineers, Los Angeles, as a civil engineer, later becoming head of the Civil Engineering Department, a post in which he was concerned with nearly every phase of pavement construction for roads and streets, highways and airfields. Earlier in his career he served a hitch in the Navy as Engineering and Supply Officer aboard amphibious craft in the Pacific. He joined The Asphalt Institute in April, 1954.

Mr. Hovater is a registered engineer in California and Arizona, a junior member of the American Society of Civil Engineers, and a member of the Society of American Military Engineers.

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Asphalt Institute Building, University of Maryland, College Park, Maryland

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BRITISH AMERICAN OIL CO. LTD.
Toronto, Ontario, Canada

BRITISH PETROLEUM COMPANY LTD.
London, England

BYERLYTE CORPORATION
Cleveland, Ohio

THE CARTER OIL COMPANY
Billings, Montana

CITIES SERVICE OIL COMPANY (PA.)
New York, N. Y.

COL-TEX REFINING COMPANY
Oklahoma City, Oklahoma

COSDEN PETROLEUM CORPORATION
Big Spring, Texas

DERBY REFINING COMPANY
Wichita, Kansas

DIAMOND ASPHALT COMPANY
Chinook, Montana

D-X SUNRAY OIL COMPANY
Tulsa, Oklahoma

EMPIRE PETROLEUM COMPANY
Denver, Colorado
Sheboygan, Wisconsin

EMPIRE STATE OIL COMPANY
Thermopolis, Wyoming

ENVOY PETROLEUM COMPANY
Long Beach, California

ESSO STANDARD OIL COMPANY
New York, N. Y.

FARMERS UNION CENTRAL EXCH.
Billings, Montana

HUNT OIL COMPANY
Dallas, Texas

HUSKY OIL COMPANY
Cody, Wyoming

HUSKY OIL & REFINING LTD.
Calgary, Alberta, Canada

IMPERIAL OIL LIMITED
Toronto, Ontario, Canada

KERR-McGEE OIL INDUSTRIES, INC.
REFINING DIVISION
Oklahoma City, Oklahoma

LEONARD REFINERIES, INC.
Alma, Michigan

LION OIL COMPANY
A DIVISION OF MONSANTO CHEMICAL CO.
El Dorado, Arkansas

MACMILLAN PETROLEUM CORP.
El Dorado, Arkansas
Los Angeles, California

MALCO ASPHALT & REFINING CO.
Roswell, New Mexico

MONARCH REFINERIES, INC.
Oklahoma City, Oklahoma

A.B. NYNAS-PETROLEUM
Nynashamn, Sweden

THE OHIO OIL COMPANY
Findlay, Ohio

PAN-AM SOUTHERN CORPORATION
New Orleans, Louisiana

PHILLIPS PETROLEUM COMPANY
Bartlesville, Oklahoma

RAFFINERIE BELGE DE PETROLES, S.A.
Anvers, Belgium

RICHFIELD OIL CORPORATION
Los Angeles, California

ROYALITE OIL COMPANY, LIMITED
Calgary, Alberta, Canada

JEFF P. ROYDER
Houston, Texas

SHELL OIL COMPANY
New York, N. Y.

SHELL OIL COMPANY
San Francisco, California

SHELL PETROLEUM COMPANY LTD.
London, England

SINCLAIR REFINING COMPANY
New York, N. Y.

SOCONY MOBIL OIL CO., INC.
New York, N. Y.

THE SOUTHLAND COMPANY
Yazoo City, Mississippi

**THE STANDARD OIL COMPANY
OF BRITISH COLUMBIA, LTD.**
Vancouver, B. C., Canada

THE STANDARD OIL COMPANY
(AN OHIO CORPORATION)
Cleveland, Ohio

SUN OIL COMPANY
Philadelphia, Pennsylvania

THE TEXAS COMPANY
New York, N. Y.

UNION OIL COMPANY OF CALIFORNIA
Los Angeles, California

WITCO CHEMICAL COMPANY
PIONEER PRODUCTS DIVISION
New York, N. Y.



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